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Effects of the reduction of the hydraulic retention time to 1.5 days at constant organic loading in CSTR, ASBR, and fixed-bed reactors – Performance and methanogenic community composition

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ABSTRACT

The hydraulic retention time (HRT) is one of the key parameters in biogas processes and often it is postulated that a minimum HRT of 10–25 days is obligatory in continuous stirred tank reactors (CSTR) to prevent a washout of slow growing methanogens. In this study the effects of the reduction of the HRT from 6 to 1.5 days on performance and methanogenic community composition in different systems with and without immobilization operated with simulated thin stillage (STS) at mesophilic conditions and constant organic loading rates (OLR) of 10 g $L^{-1}d^{-1}$ of volatile solids were investigated. With the reduction of the HRT process instability was first observed in the anaerobic sequencing batch reactor (ASBR) (at HRT of 3 days) followed by the CSTR (at HRT of 2 days). The fixed bed reactor (FBR) was stable until the end of the experiment, but the reduction of the HRT to 1.5 days caused a decrease of the specific biogas production to about 450 L kg^{-1} of VS compared to about 600 L kg^{-1} of VS at HRTs of 4–5 days. *Methanoculleus* and *Methanosarcina* were the dominant genera under stable process conditions in the CSTR and the ASBR and members of *Methanosaeta* and *Methanospirillum* were only present at HRT of 4 days and lower. In the effluent of the FBR *Methanosarcina* spp. were not detected and *Methanosaeta* spp. were more abundant then in the other reactors.

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